High Strength Weight Reduction Materials

New ASTM Standard Test for Friction-Reducing Engine Materials

Background

Friction between moving parts robs engines of useful energy and lowers vehicle fuel economy. Depending on an engine's speed, the piston ring and liner system can account for over 50 percent of the total engine frictional losses. New materials, lubricants, and coatings can potentially reduce frictional losses; but the development cost for such materials can be high, especially when full-scale engine tests are involved. This project was initiated to develop a smaller-scale, cost-effective simulative laboratory test that correlated well with the material and lubricant performance in actual engines.

Key elements required for effective ring/liner simulation were identified in FY 2001. In FY 2002, an industry advisory group was formed under the ASTM Committee G-2 on Wear and Erosion, and in FY 2003, friction and wear tests were conducted using new diesel and well-characterized, used diesel engine oils. In FY 2004, a draft standard practice was written and reviewed by the industry advisory group. After formal balloting, a new standard practice for friction

testing was approved by ASTM in early FY 2005 and designated as ASTM G-181-04.

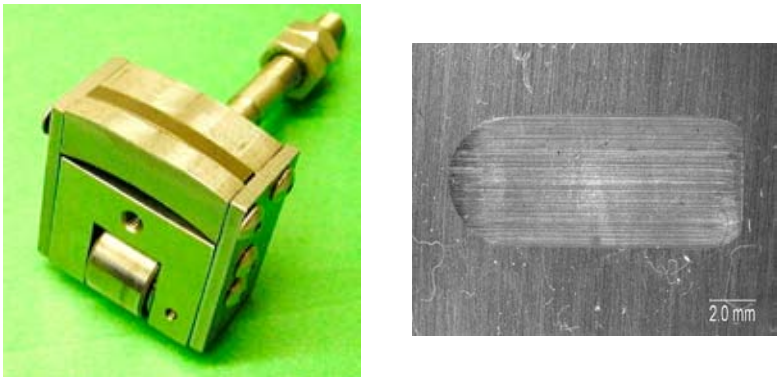


Figure 1. *(Left) The new test uses piston ring segments from production engines, held in place on specially-designed holders cut from diesel engine pistons. (Right) A typical wear mark from a 6-hour test on cast iron using high-soot diesel oil.*

Technology

A combination of mechanical, thermal, chemical and materials factors all interact to result in friction and wear behavior. Each of these variables was considered in developing the standard diesel engine ring and liner friction test. Because

Benefits

- Provides ability to screen promising new materials and surface treatments for possible piston ring and liner use.
- Simulates the effects of realistic engine oils on friction, accounting for effects like exhaust gas recirculation, oil acidity, and soot build-up.

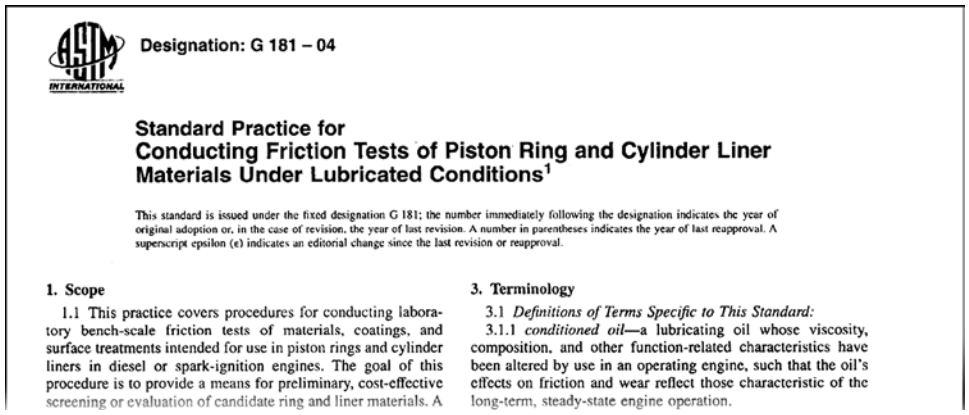
engine designs differ, the standard was developed so testing parameters could be adjusted to simulate a range of engines and lubricant characteristics.

A set of well-characterized, standard test oils from Southwest Research Institute was used to verify the ability of the new test method to detect effects of oil condition on the friction of new, lightweight engine materials.

Commercialization

The new ASTM standard practice for friction testing is now ready to assist diesel engine designers and manufacturers in selecting new materials and surface treatments for piston rings and liners. The Oak Ridge National Laboratory (ORNL) will include the new procedure within the suite of friction and wear research capabilities offered to industry for collaborative research under the High Temperature Materials Laboratory User Program.

A companion ASTM standard for wear testing of piston rings and cylinder liners is also under development under ORNL leadership. It will soon provide the ability to cost-effectively



Designation: G 181 – 04

Standard Practice for Conducting Friction Tests of Piston Ring and Cylinder Liner Materials Under Lubricated Conditions[1]

This standard is issued under the fixed designation G 181; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers procedures for conducting laboratory bench-scale friction tests of materials, coatings, and surface treatments intended for use in piston rings and cylinder liners in diesel or spark-ignition engines. The goal of this procedure is to provide a means for preliminary, cost-effective screening or evaluation of candidate ring and liner materials. A

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *conditioned oil*—a lubricating oil whose viscosity, composition, and other function-related characteristics have been altered by use in an operating engine, such that the oil's effects on friction and wear reflect those characteristic of the long-term, steady-state engine operation.

Contacts

Dr. Peter J. Blau
Oak Ridge National Laboratory
(865) 574-5377
blaupj@ornl.gov

Philip S. Sklad
ORNL Project Manager
Oak Ridge National Laboratory
(865) 574-5069
skladps@ornl.gov

James Eberhardt
DOE Technology Manager
Department of Energy
(202) 586-8032
james.eberhardt@ee.doe.gov

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.